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Using Performance Indexing to Measure Organizational Gains in White Collar Environments

B. Charles Tatum
Delbert M. Nebeker
Paul H. De Young

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Performance indexing is a useful tool for developing a measurement system of organizational effectiveness. It is particularly useful in white collar organizations because it identifies and measures the outputs that are critical to organizational effectiveness. Performance indexing can be used as a basis for making a Productivity Gain Sharing (PGS) payout. This is demonstrated by (1) showing the steps that are required to build a performance index table and (2) describing the formulae that can be used for making a PGS payout. In addition to measuring product and service outputs, the performance index also allows organizations to track other dimensions of performance that are important indicators of organizational effectiveness.

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Foreword

This report describes the use of performance indexing in developing a measurement system of organizational effectiveness. The report shows how performance indexing can be used to calculate a gain sharing payout or as an indicator of improvements in total quality.

This report is one of a series of reports on measurement issues related to productivity gain sharing and total quality. The other reports in this series are: (1) *An Approach to Measurement of Quality and Productivity for Gain Sharing: Measuring Total Organizational Value* (Nebeker & Tatum, 1996), (2) *Examples of White Collar Measurement Using a Typology of Organizational Effectiveness* (Nebeker, Tatum, & Wolosin, 1996), and (3) *Integrating Measurement Approaches in Gain Sharing and Total Quality* (Tatum, Shaw, & Main, 1996).

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Summary

Problem and Background

Performance measurement can be a problem in white collar organizations because often the performance measures for these organizations cover a wide variety of unrelated activities. This is particularly a problem for those organizations who are considering a Productivity Gain Sharing (PGS) plan because productivity measurement depends on an accurate measurement system of organizational performance.

Objective

The purpose of this report was to describe performance indexing as an approach to measurement, particularly for white collar organizations. In addition, the report attempted to demonstrate how performance indexing can be used to calculate a gain sharing payout.

Approach

The steps required to build a performance index table are shown. Each step is described with examples given from a hypothetical software organization. Also shown is how the performance index table can be used as the basis for making a PGS payout.

Conclusion

Performance indexing helps to identify and measure the outputs and outcomes that are critical to organizational effectiveness. The performance index table combines many diverse measures into one interrelated format. This is accomplished in at least two ways: (1) by converting the different measures into a common metric, and then weighting each score to obtain an overall performance index; or (2) creating separate indexes for quantity and quality, and then adjusting the quantitative index by the qualitative index.

In addition to measuring outputs, performance indexing also allows an organization to track other dimensions of performance that are important indicators of effectiveness (e.g., meeting strategic objectives).

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Introduction

This report describes a general methodology for developing a performance measurement system and how this methodology can be used to calculate payouts in a Productivity Gain Sharing (PGS) system. Many of the principles that underlie this methodology are found in several other measurement approaches (e.g., Baumol, 1977; Jones, Powell & Roberts, 1990, 1991; Nebeker & Tatum, 1996; Pritchard, Jones, Roth, Stuebing, & Ekeberg, 1989; Pritchard & Roth, 1991), but the specific method presented in this report draws heavily from the Objectives Matrix approach described by Felix and Riggs (1983).

There are two important differences, however, between the present approach and that of Felix and Riggs. These differences will be elaborated upon later in this report, but briefly they are: (1) the matrix developed here (what we refer to as a "performance index table") is a table of outputs and outcomes and does not reflect the inputs (the inputs are used later in conjunction with the table to calculate a PGS bonus) and (2) our approach provides an index that is scaled in percentage values, which allows for a more direct translation of performance improvements into dollar savings.

The body of the present report describes what we call performance indexing, and uses a hypothetical software development organization as a working example. The first part of the report outlines the steps for identifying, scaling, weighting, and aggregating measures of outputs and outcomes. The final section of the report shows how performance indexing can be used to calculate the bonus pool for a PGS system.

Performance indexing is a useful approach to measurement because it can combine several diverse measures into one interrelated format. Performance indexing accomplishes this by converting the different measures into a common metric, and then weighting each score to obtain an overall performance index. Performance indexing is especially useful for white collar organizations, because often the performance measures for these organizations cover a wide array of unrelated activities. Performance indexing allows the white collar organization to convert measures of these unrelated activities into a common measure.

Figure 1 shows an example of a performance index table for a hypothetical software development organization. Although the table looks intimidating at first glance, it is really quite simple in concept and design. The steps required to build a performance index table are shown on the right-hand margin of the figure. Each step is described using examples taken from our hypothetical software organization.

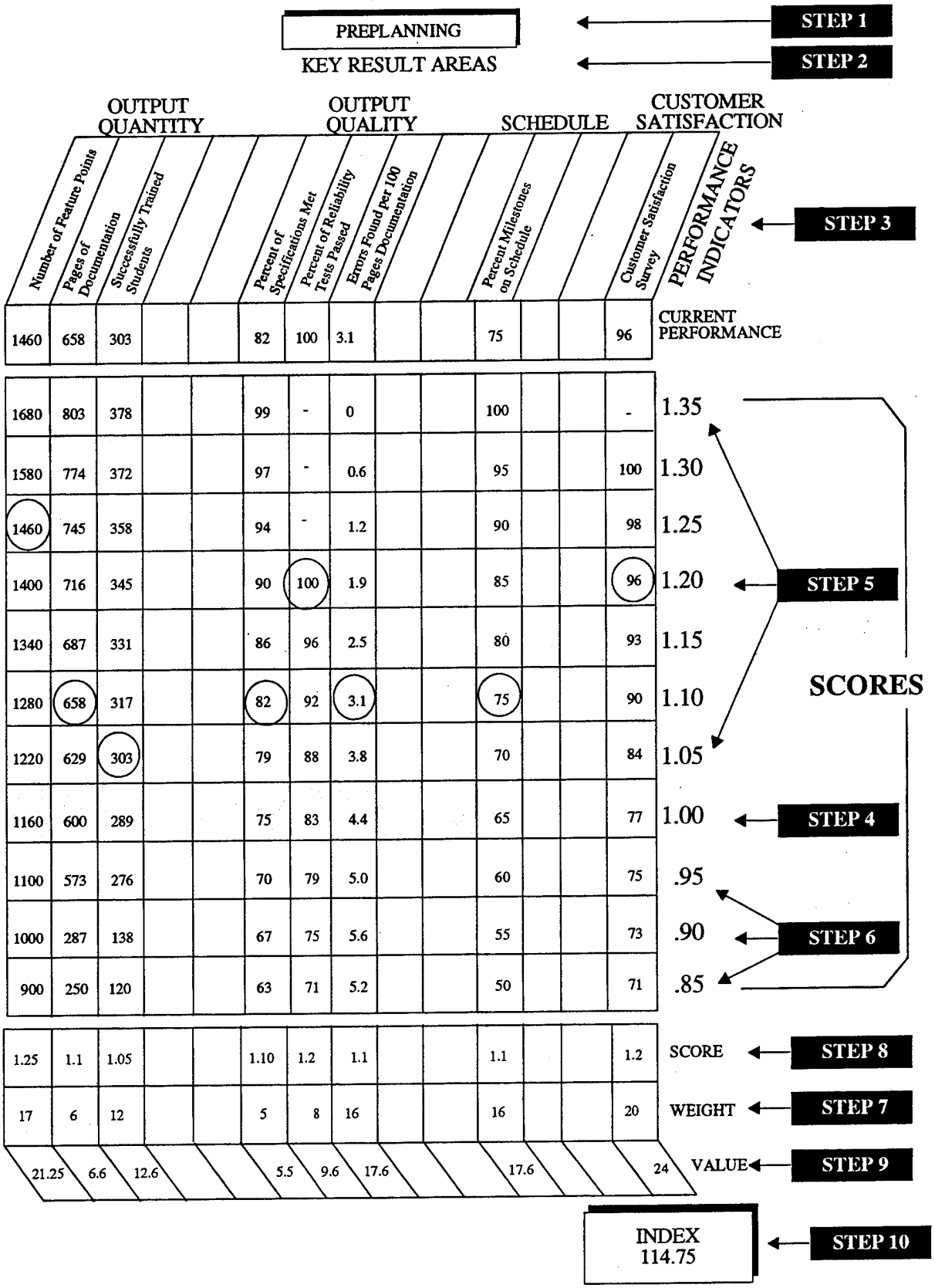
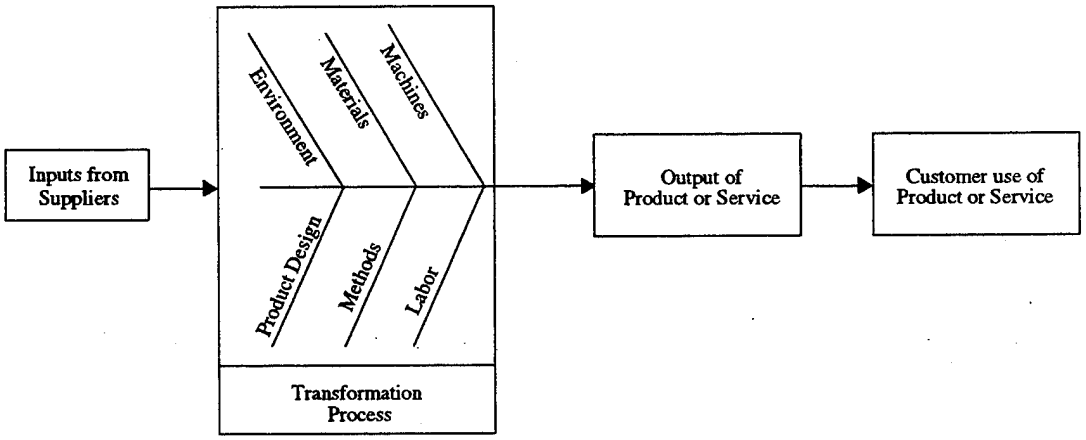


Figure 1. Performance index table for a hypothetical software organization (adapted from Felix & Riggs, 1983).

Developing a Performance Index Table

Step 1: Preplanning

Following the advice of Tuttle and Sink (1984), the first step requires gathering background data on the organization so that a system diagram of the organization can be constructed. The diagram will help guide the selection of Key Result Areas (Step 2) and should contain the following information: (1) environmental demands on the organization, (2) inputs into the organization, (3) outputs from the organization, (4) the impacts the outputs have outside the organization (e.g., on customers, the community, sponsors), and (5) significant internal processes. Figure 2 is an example of a system diagram.



Suppliers:	Inputs:	Outputs Indicators:	External Customers:	Customer Indicators:
Users	Software requirements	Specific adherence	Coast Guard	Progress reviews
Contractors	Change requests	Schedule adherence	Drug Enforcement Agency	Efficiency reviews
Labor markets	Technical questions	Software changes	Private Industry	Mobilization exercises
Technical schools	Trouble reports	Source lines of code	Foreign military	Trouble reports
Universities	Software tools	Mean time between failures	Air Force	User complaints
Software vendors	Capital	Site visits	Marine Corps	Customer surveys
Sponsors	Equipment	Product memory use	Navy	
Testers	Labor	Certifications		
	Energy	Metric analysis		
		Feature points		
		Operational tests		
		Development tests		
		Documentation		
		Training		
		Trouble calls		
		System installations		
		Consultations		
		Recommendations		
		Life cycle support		
		ADP services		

Note. ADP = automated data processing.

Figure 2. Example of a system diagram for a hypothetical software production process in a Department of Defense organization.

Step 2: Identify Key Result Areas

Every organization should have a mission, vision, and guiding principles statement as essential elements of a strategic plan for accomplishing their goals. From this document and the diagram developed in Step 1, top management can discern the key performance areas that are absolutely essential to meeting the organization's mission and strategic goals. These broad performance areas are the Key Result Areas (Tuttle and Sink, 1984; Tuttle and Weaver, 1986) and must be established by the top management of the organization as the first step in creating a performance index table (see Tuttle, Wilkinson, & Mathews, 1985, for excellent examples of the process used to generate key result areas). In our software organization, the Key Result Areas are listed across the top of the table and are labeled Output Quantity, Output Quality, Schedule, and Customer Satisfaction. In other words, for this organization, given the resources available, its mission and goals are accomplished by maximizing the output of its operation, continuously improving the quality of its products and services, meeting its delivery schedules, and satisfying its customers. All of these Key Result Areas reflect some aspect of the outputs or outcomes of the organization. It is important to understand that inputs to the organization are not part of these Key Result Areas. The inputs are important, but they are assessed separately from the key results and are not part of the performance index table depicted in Figure 1.

Step 3: Develop Performance Indicators

The Key Result Areas are the broadly conceived areas that impact the mission and strategic goals of the organization. These Key Result Areas are not useful unless there are specific indicators that tell the organization how they are performing with regard to the key areas. Performance Indicators are the specific ways in which the Key Result Areas are measured. In other words, Performance Indicators provide a quantitative index of each Key Result Area. Each Key Result Area must have at least one Performance Indicator, but ideally there should be several. As a rule, the more Performance Indicators there are for a Key Result Area, the more confidence you can have that you have a meaningful measure of that area. However, if too many Performance Indicators are used, it becomes difficult to understand how they all work together as a reflection of the Key Results Area. Therefore, two or three indicators are usually ideal.

Confidence in the indicators is also increased if the Performance Indicators are stable, they measure what they are supposed to measure, and they are collected in a systematic and orderly fashion. (See Nebeker, Tatum, & Wolosin, 1996) for a more thorough discussion of the properties of a good measurement system). There are techniques available in text books on measurement theory for estimating the validity and reliability of the Performance Indicators (Allen & Yen, 1979). These techniques are only useful if an organization has been collecting data on Performance Indicators for several years. Organizations in the initial stages of developing Performance Indicators will ordinarily defer reliability and validity analyses until after they have some history with the Performance Indicators.

Figure 1 shows the Performance Indicators under each Key Result Area for the hypothetical software organization. For example, under the Key Result area of Output Quantity, there are three indicators: (1) number of feature points, (2) pages of documentation, and (3) successfully trained students. These three Performance Indicators capture what is meant by Output Quantity in this organization.

Let us examine the first indicator to illustrate what is meant. Feature points are used in the software development industry to measure productivity (Jones, 1988) and are similar to function points developed at IBM (Albrecht, 1979). Each feature point represents a significant feature (e.g., output data, master file) of the software product delivered to the customer. Obviously, the more feature points delivered, the greater the output quantity. Thus, for the software organization in this example, delivering software features to the customer is an important part of their mission. In a similar fashion, documenting the software and training people to use the software are significant parts of the organization's mission.

Just as with the Key Result Area of Output Quantity, the other areas have Performance Indicators. For example, specification adherence, reliability of the software, and software defects are indicators of quality. Likewise, meeting milestones is an indicator of the Schedule Key Result Area, and a survey of customer satisfaction measures the Customer Satisfaction Key Result Area. With respect to schedule and customer satisfaction, it would be better if there were more than a single indicator for each of these, but sometimes it is difficult for an organization to come up with even a single indicator. If this is the case, it is better to start out with a single indicator, and then develop additional indicators over time as you gain more experience in measuring your Key Result Areas.

Step 4: Establish Baseline Performance Levels

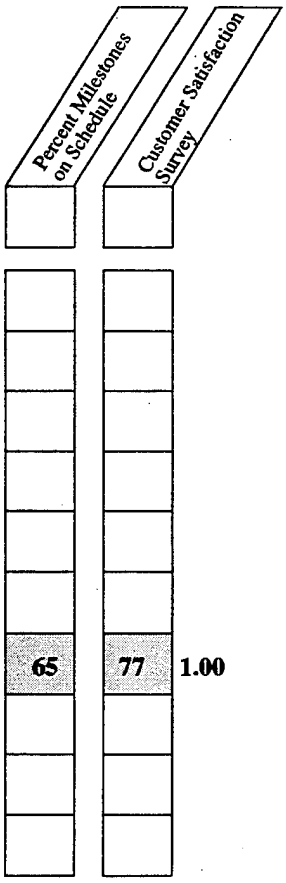


Figure 3. Establishing a baseline performance level.

Once all of the Performance Indicators are identified, it is necessary to establish a baseline level of performance for each indicator (i.e., the level of performance to which future performance is compared). Past performance (i.e., the level of performance up until now) or some target level of performance (e.g., performance mandated by or negotiated with headquarters) becomes the baseline. The absolute values of the baseline performance for each indicator is entered into the table in the fourth row from the bottom marked with the number 1.00 on the right-hand margin. As seen in Figure 3, in our hypothetical software organization, the baseline level of Customer Satisfaction is 77, and this number appears in the column (labeled "Customer Satisfaction Survey") of row 4. Similarly, the baseline level for "Percent Milestones on Schedule" is 65%, and this number also appears in row 4.

It is very important that the baseline level of performance for each Performance Indicator is carefully selected. Ideally, the baseline level is a stable and accurate reflection of the organization's current state. Usually, the baseline level is computed from data collected over a lengthy period. It is not uncommon to find baseline levels

based on data collected every quarter for a period spanning 3 to 5 years. Obviously, the longer the period of data collection, the more confidence the organization has that these measurements are a stable and accurate reflection of their current capability. If an organization plans to use historical data, but does not have existing measures, the organization should undergo a period of data collection to establish a stable baseline of performance. This will of course delay the development of the performance indexing, but this method is only as good as the data that are entered.

Step 5: Set Performance Goals

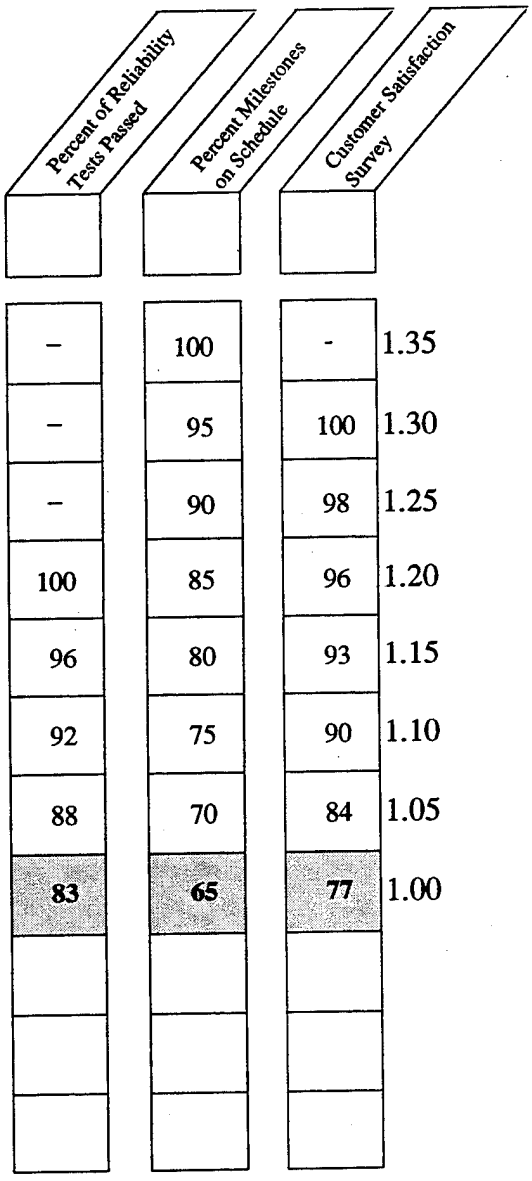


Figure 4. Establishing higher performance levels.

After you have established your baseline level of performance on all of the indicators, the next step is to set goals for performance levels above the baseline level. As shown in Figure 4, there are seven rows above row 4 that are marked with scores ranging from 1.05 to 1.35 on the right hand margin. Each successive row represents an increasing level of performance above the baseline performance in row 4. In the best case, these goal levels are determined empirically by known relationships between performance and the value of each successive level. However, establishing these successive goal levels can be based on expert judgment or be estimated by a committee or group of stakeholder knowledgeable about the relationships between performance and value. In any case, the best approach is to enter a high goal in the top row (score of 1.35), so that it represents a 35% increase in the value of the indicator. Then the values for each descending row (scores 1.30 to 1.05) should be selected so they represent progressively less difficult goals as you proceed downward to the baseline (score 1.00). The top row should be a goal that is very difficult to meet; a goal that, if met, would mean that the organization had increased its outputs or outcomes substantially. For example, let us suppose that the last column of the table, Customer Satisfaction, is obtained by a survey in which the customer rates the organization's software products and services on a 1 to 100 scale. Obviously, obtaining a score of 100 is the best score this organization can achieve. Therefore, 100 is the highest goal and is the value placed in the top row in the Customer Satisfaction column. It is not always this easy to determine what the highest goal should be, but the idea is to pick values that express substantial improvement in outputs or outcomes. In some cases, "substantial" improvement may even occur before performance reaches the 1.35 level (e.g., see the reliability tests column in Figure 1).

Selecting the values for the intermediate rows is not always simple. The easy way to do it is to take the difference between the value in row 4 (the baseline) and the value in row 10 (maximum performance) and divide this number into equal intervals. This approach assumes, however, that the value of improving from one goal level to the next is equal. This is not always the case. It is often the case that the value of achieving progressively higher levels of performance is a nonlinear function of the goal level. For example, it may not be of much value to reduce the defects in a product from 99 per thousand to 98 per thousand, but it may be exceptionally valuable to go from two per thousand to one per thousand. Considerable thought must be given on how the range of values for the rows between baseline and the top row ought to be distributed. If you know that it is much more valuable to achieve the higher level goals, you might want to make the increments at the higher levels smaller than the increments at the lower levels. In this way you can make the higher goals reflect their contribution to the organizational mission, which will encourage efforts to make improvements at the high end of the scale.

Figure 5 shows this nonlinear scaling for the "Customer Satisfaction" indicator and compares it to a linear scale, "Percent Milestones on Schedule." Note how Customer Satisfaction increments become progressively smaller as we go from a score of 1.00 to 1.30. The assumption is that as Customer Satisfaction gets closer to the maximum goal of 100%, the value to the organization is greater. In Figure 5 we can see that a two unit increase in Customer Satisfaction at the high end of the scale (e.g., from 96 to 98) is as valuable as a six unit increase at the low end of the scale (e.g., from 77 to 84). Alternatively, for "Percent Milestones on Schedule," for each increment in the scores from 1.00 to 1.35, there is an equal increment in the level of the performance indicator. This shows that there is equal value to each 5% improvement all along the milestone scale.

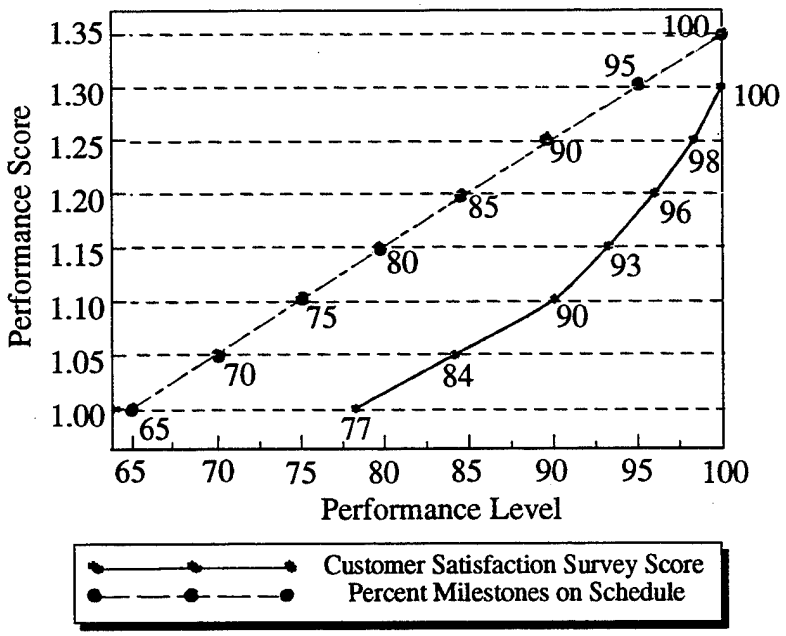


Figure 5. Linear and nonlinear relationships between performance scores and performance levels (comparisons of performance indicators for schedule and customer satisfaction).

Step 6: Set Lower Performance Levels

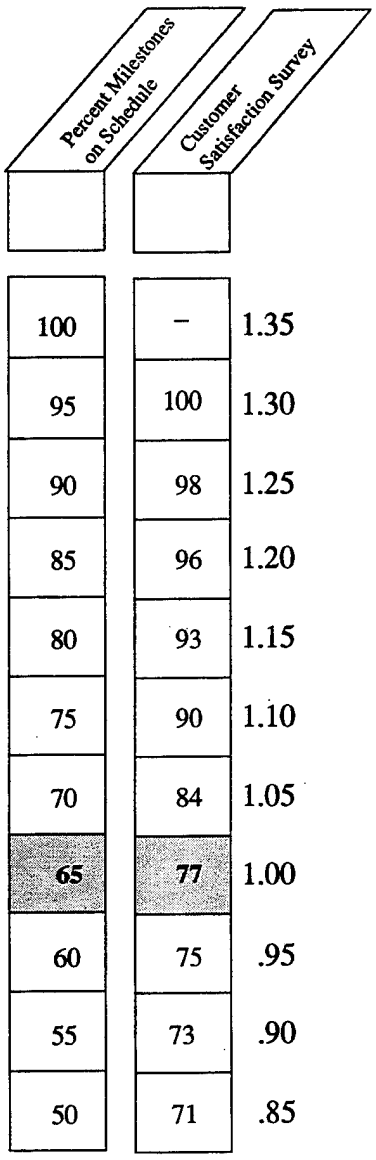


Figure 6. Establishing lower performance levels.

Although we do not like to think about performance decreasing, it is a fact of life that sometimes performance deteriorates from past levels. The bottom three rows, as shown in Figure 6, are included in the performance index table to cover those occasions in which performance drops below the baseline level. These lower levels send a message to the organization that something is amiss and corrective action must be taken. The values that are selected for these levels will be determined by the mission and strategic goals of the organization, and by what message is to be conveyed when performance drops to these levels. If the mission is to satisfy the customer above all else, then falling below the baseline level of customer satisfaction is a very serious problem. In this case, the levels below the baseline row should be scaled in very small increments so that the message is clear that even small decreases in performance are unacceptable. On the other hand, if it is common for the delivery schedule to slip, and this is not a serious problem, then the values selected for the bottom three rows may be less constrained than for some of the other indicators. In all cases, the organization wants to stress that falling below baseline performance is not good, and that each successive drop in performance below the baseline row creates a greater problem for the organization.

Step 7: Assign Weights to Performance Indicators

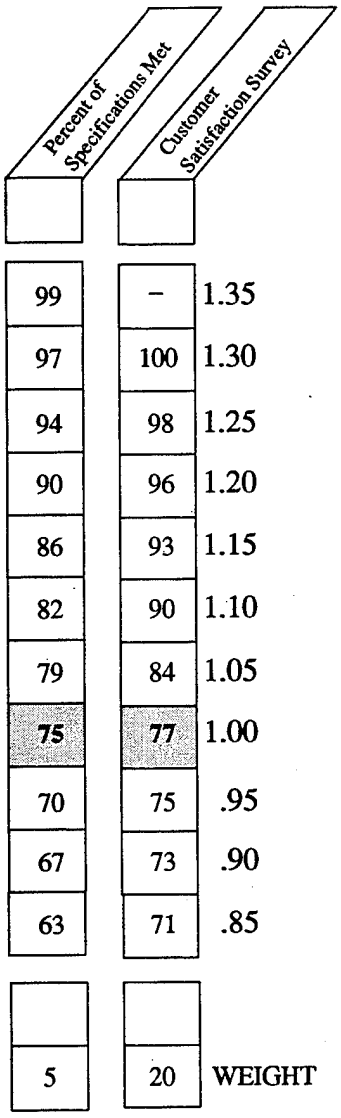


Figure 7. Comparison of two performance indicators and scores with different weights.

Not all Performance Indicators are equally important to the mission, vision, and strategic goals of the organization. In our hypothetical software organization, documentation and meeting specifications may not be as important as customer satisfaction and increasing feature point output. Assigning weights to the performance indicators is a way of denoting the relative importance of the indicators. The recommended procedure for a performance index table is to start with 100 points, and distribute those points to the various indicators in proportion to the relative importance of the indicators. In our sample table, as shown in Figure 7, we have assigned 20 of the available 100 points to customer satisfaction, and only 5 points to meeting specifications. The other indicators are likewise assigned points so that the total adds up to 100.

How does an organization decide what weight to give a particular indicator? There are both analytic and nonanalytic methods for assigning weights. Analytic methods involve devising a rational scheme for judging how much weight to give each indicator. For example, it may be possible to determine what proportion of the budget is allocated to efforts supporting each of the performance indicators. If this information is available, the weights can be tied to the budget numbers. If 20% of the budget goes toward customer support, it may make sense to assign a weight of 20 to customer satisfaction. If only 5% of the budget goes towards ensuring that the programs meet the specifications, perhaps a weight of 5 is reasonable. It should be noted, however, that in order for this method to work, the budget allocation process itself must be rational, and must indeed reflect the strategic importance of each indicator.

Nonanalytic methods for assigning weights rely on group consensus and expert opinion. The typical approach here is to bring together a group of people (e.g., top management, Executive Steering Committee) who are intimately involved in the management and operations of the organization, and "brainstorm" on what is important and what weights should be assigned. There are systematic procedures for bringing about consensus (e.g., the Nominal Group Technique). These nonanalytic methods can be very time consuming, but time and experience have shown that these methods can also be quite accurate. When customers and headquarter's activities can be made a part of this process the results will be far more satisfactory and defensible.

Step 8: Assign Scores to Performance Indicators

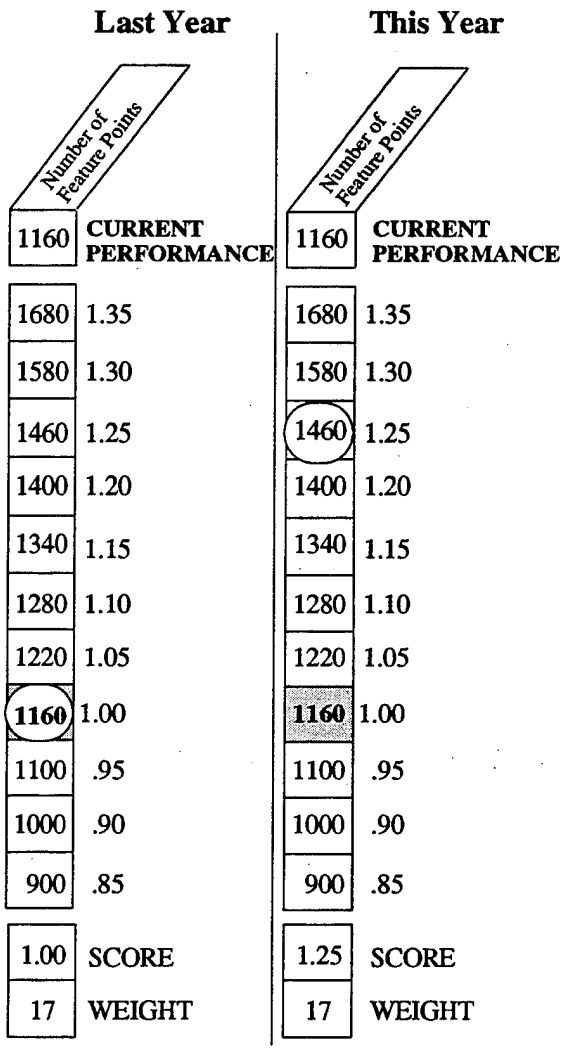


Figure 8. Comparison of 1 year's performance score to the next.

At the completion of Steps 1 through 7, the performance index table is ready to use. At this point the organization knows the level of performance on each indicator for the baseline performance period. As pointed out earlier, baseline performance levels are entered in row 4 (Step 4). Because performance for each indicator is measured on a different metric or numbering scheme (e.g., feature points are measured as raw units, schedule is measured as a percentage, customer satisfaction is measured as a survey rating), the numbers for the indicators must be converted to a common metric. This is done by assigning a common score to all indicators falling along the same row. With regard to baseline performance, all the indicators in row 4 are assigned the score 1.00. It no longer matters that baseline performance for feature points is 1160, for schedule it is 65, and for customer satisfaction it is 77. All the numbers in row 4 are reassigned a score of 1.00. In a similar vein, all the numbers in row 7 are scored as 1.15 and all the numbers in row 1 are scored as .85.[1]

The advantage of performance indexing is not only that the organization can view its overall performance at present, but it can also compare this present performance with future performance. We have forced the baseline performance numbers to take on the score of 1.00. The importance of doing this is so we can see if future performance rises above or falls below this score of 1.00. To make this comparison, we must wait a period of time (e.g., 1 year) and then recalculate the performance levels on each of the indicators.

[1]This range of scores from .85 to 1.35 is different from the scores shown in the Objectives Matrix. Felix and Riggs (1983) use a 1 to 10 point scale. The matrix (table) shown here uses a range of scores that is indexed to the proportion of change for each from the base line. This is done because the results are to be used to make bonus payouts in a PGS plan, and the payouts should reflect the relative magnitude of the performance changes that can be expected from an organization.

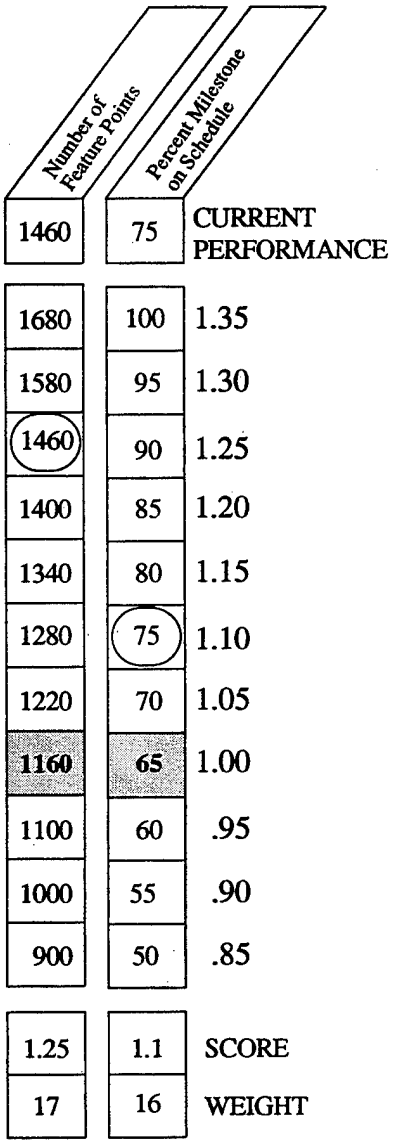


Figure 9. Comparison of one performance score to a different performance score.

When we have these new numbers, we then circle the number for each indicator that is just below the calculated number. For example, suppose that after 1 year, we recalculate the "Feature Points" indicator and discover that we are producing 1500, whereas 1 year earlier we were only producing 1160. This is obviously an improvement, but how much of an improvement? As shown in Figure 8, when we refer to the table, we see that the number just below 1500 is 1460 and so we circle that number. The reason we select the lower number is because it is a conservative estimate of the improvement and since the tabled values are goals, 1500 exceeds the goal of 1460 but does not reach the next highest goal of 1580. After we circle the appropriate number in the table, we then follow the row from left to right and determine the score for that number. In our example, 1460 feature points gets a score of 1.25. We now know that we have improved our feature point indicator from a 1.00 to a 1.25 over a 1-year period of time.

If we only had one indicator there would be no advantage to assigning the scores 1.00 and 1.25 to these feature point numbers. But, when we have multiple indicators, the scores become a common metric and we can compare across diverse sets of measures. Imagine that during that same 1-year period we went from meeting schedule 65% of the time to 75% of the time as shown in Figure 9. This is an improvement, but is it as much of an improvement as we observed for feature points? We cannot tell if we simply look at the absolute numbers for each indicator, but we can tell at a glance by comparing their scores. Since we met the goal of 75 (but not for 80), the score for our schedule indicator is 1.10. Because a score of 1.10 on schedule is not as high as a score of 1.25 on feature points, we must conclude that we improved more on feature points than we did on meeting the schedule.

The rest of the indicators are converted to scores in a similar manner, and we can now tell how much relative improvement (or slippage) there was for each indicator. We enter these scores for each indicator in the row at the bottom of the table labeled "Score." In addition, we enter the actual number for each indicator in the row at the top of the table labeled "Current Performance."

Step 9: Compute Weighted Values for Performance Indicators

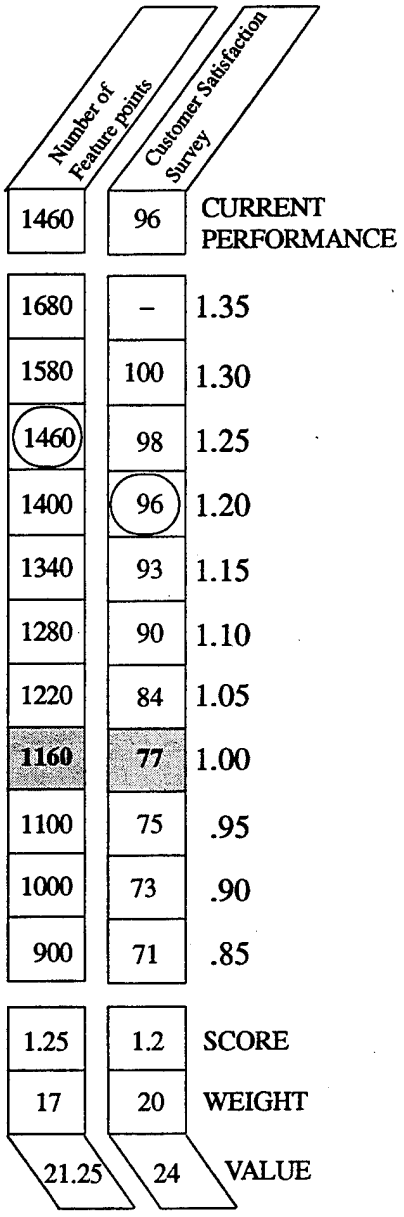


Figure 10. Comparison of weighted values for different performance indicators.

As useful as the previous step was in helping us compare relative improvement in Performance Indicators, this next step is even more valuable. This step allows us to see improvements in Performance Indicators relative to their importance to the organization. Although it is important to know that we improved our performance in "feature points," it is more important to the organization to see improvements in "customer satisfaction." Calculating the weighted values for each indicator supplies its relative importance. To obtain the weighted value, we simply multiply the score for each Performance Indicator by its given weight and enter this result in the bottom row labeled "Value" as shown in Figure 10. This number adjusts the score of each indicator by the weighted importance of the indicator and tells us how important the improvement is relative to the overall mission, vision, and goals of the organization. In the present illustration, it can be seen that despite the fact that customer satisfaction received a lower score than feature points (1.20 vs. 1.25), the weighted value is higher (24 vs. 21.25). The difference in weighted value reflects the fact that customer satisfaction is more important to the organization than output of feature points, and thus the lower score is adjusted upward by the weighting.

Step 10: Calculate an Output/Outcome Index

The last step in constructing a performance index table is to add all of the values along the bottom row of the table and place that number in the box labeled "Index" (see Figure 1). The Index is a number that reflects total output/outcome of the organization for the period being evaluated. In the current example, the index number is 114.75, which is the index number for the 1-year period following the baseline period (the baseline being the scores in row 4). The index is a reflection of the overall improvement in outputs and outcomes over the baseline period. The number 100 is the baseline index because this is the number that would result if you added all of the values for the baseline performance. Any index that exceeds 100 reflects an improvement in outputs and outcomes, and any score that falls below 100 reflects a decline in outputs and outcomes. Thus, the Index number tells you, at a glance, whether the organization's performance has improved (Index > 100) or declined (Index < 100) during any given period following the baseline.

Calculating a Productivity Gain Sharing Employee Payout

Performance indexing is a useful tool for calculating a PGS bonus pool which serves as the basis for a payout. The table in Figure 1 illustrates how an organization can measure its Key Result Areas. In the example, some Performance Indicators are outputs of products and services from the hypothetical software organization (e.g., "feature points" is a product, "students trained" is a service). Figure 1 also shows how the table can reflect the quality of these outputs (e.g., reliability tests, defects). In addition, performance indexing allows the organization to track outcomes as well as outputs (e.g., schedule adherence, customer satisfaction). The final Index from all of these indicators is an overall measure of all the outputs and outcomes that are critical to the organization.

To make a PGS payout, the organization needs to show that it has increased its productivity. Productivity is calculated by dividing the outputs/outcomes by the inputs (inputs include labor, materials, energy, and capital). If productivity during some current period is greater than productivity during the baseline period, then an improvement in productivity has occurred. The ratio of current productivity to baseline productivity is called a productivity index, and an increase in the productivity index is justification for a PGS payout. The size of the payout is determined by the size of the increase in the productivity index, and the dollar values associated with the productivity index. The remainder of this report will discuss different methods for calculating PGS payouts for different types of funding situations in the Department of Defense (DOD).

The calculation of a PGS payout from the performance index table depends on the type of funding an organization receives. Simply stated, there are two basic types of funding in DOD organizations: unit cost funding and appropriated funding. Unit cost funding occurs in those organizations that belong to what is known as the Defense Business Operations Fund (DBOF). DBOF organizations such as aviation depots, shipyards, and logistic centers have an annual "operating budget" that is determined by their unit cost efficiency, workload, and cost-cutting goals. The unit cost reflects the full cost of providing high quality products or services to the customers, and the price charged the customer is normally raised or lowered in the upcoming budget year to offset any gains or losses in the current year. The critical feature of DBOF is that these DOD activities must compete for customers, and so there is an incentive to improve quality and lower costs. To add to these existing incentives, the DOD comptroller has issued policy stating that DBOF organizations can use savings from decreased unit costs to fund PGS payouts

(Department of Defense memorandum of 9 December 1992). The first two examples we discuss will show how performance indexing can be used to calculate a PGS payout from a unit-cost (DBOF) organization.

The second type of funding is appropriated funding. This refers to organizations that receive their operating budgets with funds appropriated from Congress. The budgets from appropriated funded DOD organizations (e.g., headquarters, commands, audit services, investigative services) are relatively stable from year to year and do not fluctuate based on unit costs, workload, or cost-cutting goals. Consequently, there is no natural economic basis for justifying PGS payouts in appropriated funded organizations. There are ways, however, to use performance indexing to justify PGS payouts in these organizations, and the last two examples will outline this rationale.

Productivity Gain Sharing Payouts in a Unit-Cost Organization (Single Index Method)

The output/outcome index that is computed from the performance index table (Step 10 in Figure 1) summarizes the indicators from all of the Key Result Areas in an organization. If our hypothetical software organization were part of DBOF, this output index could be a single number that represents the "unit" in the unit-cost equation. A decrease in unit costs demonstrates that the cost per output/outcome index has declined during the current performance period relative to a historical baseline period (or, as an alternative to a historical baseline, the comparison can be with a unit-cost target which is a projection of future performance). Figures 11 and 12 illustrate two formulae for calculating the bonus pool, and either Formula A or B can be used. Formula A is easier to understand conceptually, but Formula B is easier to compute and is consistent with the formulae used in most standard PGS systems such as Scanlon, Rucker, and IMPROSHARE (see O'Dell, 1981, chapter 4).

Formula A

$$\left[\left(\frac{\text{Current Output Index/Current Costs}}{\text{Base Output Index/Base Costs}} - 1\right) \times \text{Current Costs}\right] \times \text{Sharing Rate}$$

1. Base Productivity = Base Output Index/Base Costs = 100/10,000,000 =.00001
2. Current Productivity = Current Output Index/Current Costs = 114.75/9,500,000 = .000012079
3. Productivity Index = Current Productivity/Base Productivity = .000012079/.00001 = 1.2079
4. Improvement Over Baseline = Productivity Index – 1 = 1.2079 – 1 = .2070
5. Bonus Pool (Savings) = Improvement Over Baseline x Current Costs = .2070 x $9,500,000 = $1,975,000
6. Employee Payout = Bonus Pool x Sharing Rate = $1,975,000 x .50 = $987,500

Figure 11. Formula for calculating employee payout from a performance index table.

Formula A: As stated earlier, productivity is commonly defined as output over input. In this example, we can calculate productivity by dividing the output/outcome index[2] (Step 10) from the performance index table by the costs to generate that performance. Productivity can be calculated from the performance index table for the base period and for the current period. Formula A computes productivity for the current period and divides this figure by the productivity for the base period to obtain a productivity index. If the index is greater than 1.00 then productivity during the current period is greater than productivity during the base period. When this productivity index is converted into the proportion greater than 1.0 and multiplied by the current costs, this result shows the extent of the savings arising from the improvement. The savings is the bonus pool, and a portion of this savings can be distributed to the employees as a PGS payout. How much of the savings is distributed is determined by the sharing rate. If the sharing rate is 50%, then the employees receive half of the bonus pool and the remainder is retained by the organization.

To use a simple example, suppose the baseline period was 1 year and the software developer spent $10 million to produce the 100 output/outcome index points (recall that the baseline index is always 100). In Figure 11, Base Productivity (1) is the ratio of the baseline index to the baseline costs (in this case 100/10,000,000 = .00001). Now, suppose that in a 1-year period following the baseline, the software developer lowered its costs to $9.5 million and increased its output/outcome index to 114.75 (the index shown in Step 10 from Figure 1). If we divide the 114.75 index points for this current period by the $9,500,000 in costs during that period, we obtain the Current Productivity (2). The Current Productivity equals .000012079 (114.75/9,500,000). The ratio of Current Productivity to Base Productivity is the Productivity Index (3), which is a number that reflects the degree of improvement in productivity from the baseline period to the current period (in our example, the Productivity Index is .000012079/.00001 = 1.2079). If we subtract 1.00 from the Productivity Index, we obtain the Improvement over Baseline (4). Improvement over Baseline is just another way of expressing a unit-cost reduction. The Improvement over Baseline can then be multiplied by the current costs (.2079 x $9,500,000 = $1,975,000) to get the Savings or Bonus Pool (5). The employees share of the bonus pool is determined by the sharing rate. If the sharing rate were 50%, then the Employee Payout (6) would be $987,500 ($1,975,000 x .5 = $987,500). This Employee Payout total can then be distributed to each of the eligible employees according whatever distribution rule has been agreed upon.

Formula B: This formula (shown in Figure 12) is the algebraic equivalent to Formula A, but is a bit easier to calculate because there are fewer steps involved. The Base Unit Cost (1) is computed by dividing the costs during the baseline period by the output/outcome index during the baseline period (using the same example as above, the Base Unit Cost = $10,000,000/100 = $100,000). The Base Unit Cost is then multiplied by the costs during the current performance period to yield the Expected Costs (2), which in the present example is $100,000 x 114.75 = $11,475,000. If we then subtract the current costs from the expected costs ($11,475,000 - $9,500,000 = $1,975,000) we obtain the Savings or Bonus Pool (3), which as you can see is the same figure we calculated from Formula A. The Employee Payout (4) is again determined by the sharing rate, and the amount received by each employee depends on the eligibility and the distribution rules.

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[2]We use the terms output and outcomes interchangeably in this context. Technically, outputs are the actual products and services of an organization, whereas outcomes are the measurable effects these products and services have on the end-users (e.g., customers). For our purposes here, increases in productivity can result from improvements in both outputs and outcomes.

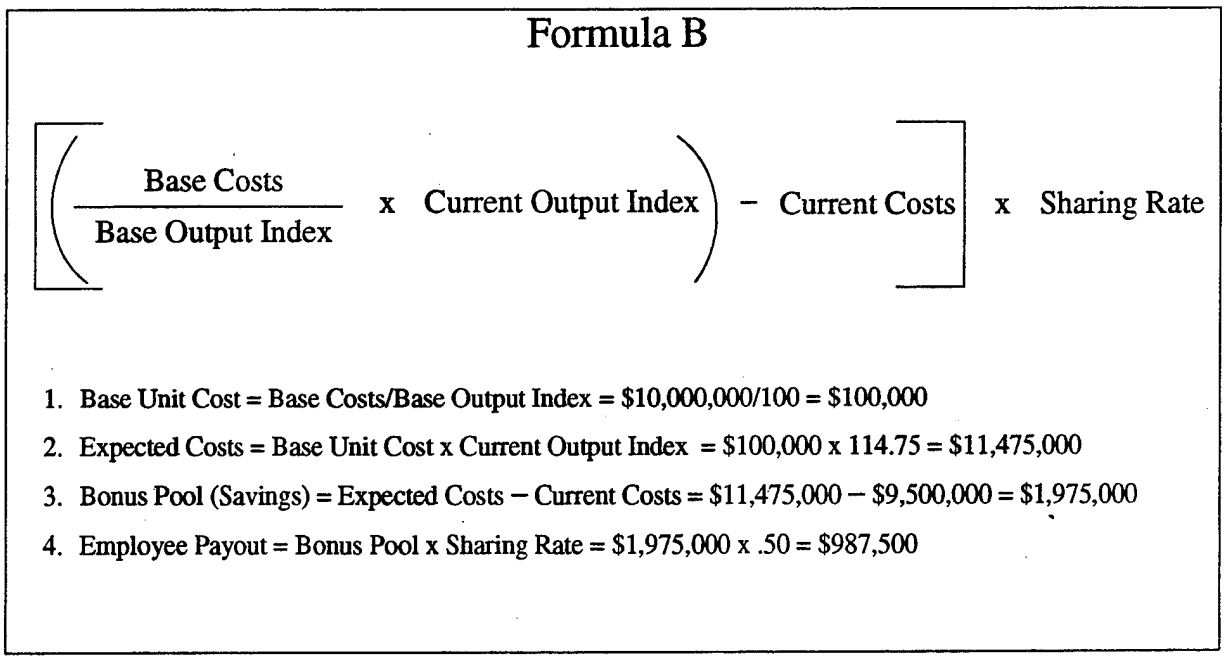

Figure 12. Alternative formula for calculating employee payout from a performance index table.

This single index method of unit costing, where all performance indicators are combined into a single output/outcome index, has at least two advantages. First, it is consistent with principles of total quality management in that there is a focus on quality by integrating quality and quantity. Quality is not an after-thought in the single index method, quality is an integral part of what defines a unit of service or production. The second advantage to the single index method is that there is a natural incentive to improve quality because, all other things being equal, increases in quality lead directly to lower unit costs.

Productivity Gain Sharing Payouts in a Unit-Cost Organization (Separate Index Method)

An alternative to the single index method discussed above is the separate index method. In the separate index method, Key Result Areas are isolated and form separate performance index tables. For example, the three indicators of Output Quantity in the software organization (feature points, pages of documentation, and trained students) can be placed into a performance index table that reflects only performance quantity. Likewise, the remaining indicators for Output Quality, Schedule, and Customer Satisfaction can form a second table reflecting performance quality. These two tables yield separate indices that are treated separately and independently for the purpose of tracking performance changes and making PGS payouts.

There are two advantages to the separate index method. First, it is easier for people to monitor and control their performance if it is separated into distinct categories. Management and the workers can see the impact of their improvement efforts on different indices, and it is clear what dimensions of performance are changing. The second advantage to the separate index method is that it is consistent with most current financial-accounting systems. Accounting systems in DOD

are not equipped to handle unit costs when the "unit" represents an integration of quality and quantity. These systems are based on a quantitative accounting of products or services, with quality used as an adjustment or "leveling" factor. Given this type of accounting practice, it makes more sense to separate quantity and quality into distinct tables. Unit cost savings and potential PGS payouts can be calculated from the quantitative index, and then the quality index can be used to adjust the unit costs and the payout. For example, if the quantitative index showed a 20% improvement over the baseline period, but the qualitative index showed a 2% decline, then the payout could be adjusted downward based on a low qualitative index. This is the approach recommended by the DOD Comptroller (Memorandum dated 9 December 1992).

Productivity Gain Sharing Payouts in an Appropriated Fund Organization (Single Index Method)

Let us suppose now that our software organization is not part of DBOF, but rather gets its funding from appropriations. At the beginning of each fiscal year, it receives a finite amount of money to cover its expenses in areas such as labor, supplies, energy, and capital investments. Part of the budget is allocated for performance awards (generally 1.5% of payroll) and incentive awards (this amount varies, but .5% of payroll is not unreasonable). The money available for performance and incentive awards can be used as a bonus pool for payouts in a PGS plan.

Suppose the total budget is $30 million with $10 million budgeted for payroll. The combined bonus pool from performance awards and incentive awards is $200,000 (1.5% + .5% = 2.0% of payroll). This bonus pool is available to the organization to distribute for performance awards, special acts awards, beneficial suggestions, and so forth. The organization can use all or some portion of this money to fund a PGS payout based on the index from the performance index table and cost reductions. For example, our software organization could decide that if current productivity (i.e., the current output/outcome index divided by the current costs) increases 4% above baseline productivity (baseline index divided by baseline costs), then all of the bonus pool will be distributed to the eligible employees. Requiring a 4% improvement in productivity to receive all of the bonus pool is based on 2% of payroll being budgeted for awards and a 50% sharing rate. If the productivity fails to reach this 4% increase, then the organization will only distribute a portion of the bonus pool, and with appropriate approvals, the unused portion of the pool can be used for other purposes (e.g., training, capital improvements or other improvements to the organization).

The example so far assumed that the bonus pool was fixed at 2% of payroll. It is also possible to use cost savings to increase the size of the bonus pool, but this must be carefully negotiated with the headquarters' command that sets the budget each year. For example, suppose the software organization believed that it could achieve cost savings in certain areas (e.g., personnel, supplies) totaling 6% of payroll, it could negotiate with its headquarters for authority to make the performance and incentive awards pool larger than normal to reflect savings in these other areas. Part of the negotiation might include an agreement to return some portion of the savings (e.g., half) to headquarters prior to the end of the year, in time for headquarters to use it for some other purpose. The remaining half of the savings would go into the bonus pool. An alternative might be an agreement to reduce next year's budget by some portion of the savings. In this example, the performance and incentive award pool could be increased to 8% of payroll (2% from the awards budget and 6% from cost reductions).

The employees would then have an incentive to reduce costs in these areas because this would increase the bonus pool and the size of the payout. If the anticipated cost reductions fall short of 6%, then the bonus pool would remain at the minimum 2% level plus some smaller amount that reflects the actual cost reductions achieved. If no cost reductions occurred, then the bonus pool would only be 2% of payroll (the amount of the performance and incentive awards pool). This approach is a win-win situation for both the organization and its headquarters. The employees in the software organization have a financial incentive to increase performance and reduce costs. Headquarters cannot lose financially because no additional funds are requested, and there is a good chance that money either will be returned or next year's budget outlays will be reduced.

Figure 13 provides a working example of how a PGS system might work in an appropriated fund activity. Figure 13 is a step-by-step approach to combining funds from the awards budget and cost reductions, along with the index from the performance index table, to obtain a total bonus pool for the organization. Figure 13 is based on the calculations in Formula B (Figure 12) because this is the clearest approach to deriving a payout. The following discussion will describe each step and explain the rational behind each calculation.

STEP 1.	Total Base Costs	$30,000,000
STEP 2.	Base Index from Performance Index Table	100
STEP 3.	Base Unit Cost (divide STEP 1 by STEP 2)	300,000
STEP 4.	Current Index from Performance Index Table	114.75
STEP 5.	Expected Costs (multiply STEP 3 by STEP 4)	34,425,000
STEP 6.	Current Total Costs	29,400,000
STEP 7.	Total Savings (subtract STEP 6 from STEP 5)	5,025,000
STEP 8.	Savings to be Potentially Shared (multiply STEP 7 by .5)	2,012,500
STEP 9	Potential Awards Pool: Funds from Performance and Incentive Awards Budget	200,000
STEP 10.	Bonus Pool # 1: Awards Pool	
	a. If STEP 8 is less than or equal to zero, enter zero	_____
	b. IF STEP 8 is less than STEP 9, enter STEP 8 and make payout	_____
	c. If STEP 8 is greater than or equal to STEP 9, enter STEP 9 and continue with STEP 11	200,000
STEP 11	Undistributed Savings (subtract STEP 10 from STEP 8)	1,812,500
STEP 12	Current Year Budget Appropriation	30,000,000
STEP 13.	Amount of Cost Reductions Reallocable to Awards (Negotiated with Headquarters)	1,000,000
STEP 14.	Current Cost Reductions (subtract STEP 6 from STEP 12)	600,000
STEP 15.	Bonus Pool # 2: Cost Reduction Pool	
	a. If STEP 11 is less than or equal to zero, enter zero	_____
	b. IF STEP 11 is less than STEP 13, enter STEP 11	_____
	c. If STEP 11 is greater than or equal to STEP 13, enter STEP 13	600,000
STEP 16.	Total Bonus Pool: Employee Payout (add STEP 10 and STEP 14)	800,000

Figure 13. Steps for calculating a Productivity Gain Sharing payout in an appropriated fund organization (based on Formula B).

Step 1: This is the total cost of running the organization during the baseline period. If baseline data were collected for 1 year, then this value would be the total operating budget for that baseline year. If the baseline were longer than 1 year, the value would be the average total cost over those years. This figure can be obtained from the comptroller's office.

Step 2: This is the output/outcome index from the performance index table for the base period. This number will always be 100 if the table in Figure 1 is used.

Step 3: This represents the unit costs for the baseline period, which is obtained by dividing the total baseline cost by the index from the baseline period.

Step 4: This is the output/outcome index from the performance index table for the current period (Step 10 in Figure 1). This represents the increase (or decrease) in the performance index over the baseline period.

Step 5: This number represents the expected costs for the current period. In other words, given the unit costs for the baseline period (Step 3), the number in Step 5 is what you expect the units (output/outcome index) from the current period to cost. As you can see, given what the organization spent during the baseline period to produce 100 units, we expect the 114.75 current units to cost $34,425,000.

Step 6: This number is the actual amount spent during the current period. Because the organization was expected to spend $34,425,000 to produce the 114.75 units, the $29.4 million they actually spent represents a savings in total costs.

Step 7: This number represents the total savings achieved by the organization. That is, this number is the difference between what they should have spent (Step 5) and what they actually spent (Step 6).

Step 8: The savings that can be shared with employees is calculated as 50% (the Sharing rate) of the total savings realized.

Step 9: This is the total amount of money from the performance and incentive awards budget that will be used to fund part of the PGS bonus pool. In our example, the amount is $200,000 because this is 2% of the organizations $10 million payroll.

Step 10: This step determines how much money goes into the first of two bonus pools. This first pool is money taken exclusively from the awards budget. How much of the $200,000 total is actually used is determined by the amount of shareable savings from Step 8. In case (a), if there were no savings (i.e., if the organization was unable to generate outputs and outcomes at a cost lower than the baseline unit cost) then no bonus pool is available because the organization has shown no productivity improvement. On the other hand, in case (b), if there were shareable savings, but these savings did not exceed the amount of money in the awards budget, then not all of the potential awards pool (Step 8) can be made available for a payout. In case (b) the amount of shareable savings is less than the Awards Budget. Therefore, only the amount of the shareable savings (Step 8) from awards pool is distributed to the employees as a payout. The remaining money in the awards pool is either returned to headquarters or will appropriate approvals it can be converted to other uses by the organization for making improvements. The last case (c) is the situation in which the savings are greater than the potential awards pool. In this case, all of the

money in the awards pool ($200,000) can be distributed to the employees as a payout. In addition, there may be sufficient savings to justify setting up a second bonus pool that will increase the size of the payout.

Step 11: This number reflects the net savings after the funds from the awards pool (Step 10) is deducted from the sharable savings (Step 8).

Step 12: This is the current year's budget that was negotiated with Headquarters.

Step 13: The organization may negotiate with its headquarters an amount that can be added to their Awards Budget on the condition that costs reductions greater than the appropriated budget are realized. This allows the headquarters to preapprove a change in budget allocation if there is a net reduction in total organizational costs. The amount agreed to in this example is $1,000,000.

Step 14: This figure is the current cost reductions over the target budget. In other words, this is the difference between the dollars available from the appropriations provided by Headquarters (Step 12) and the dollars spent during the current period (Step 6). Adding money to the bonus pool can only be justified if there is an actual reduction in real cost (e.g., reduction in costs over budget). If there is a real cost reduction, then some or all of these funds can go into a second bonus pool.

Step 15: This is the amount of money that goes into the second bonus pool from cost reductions. If the Undistributed Savings (Step 11) are less than or equal to zero, then obviously there is no money available for this pool (a). Case (b) covers the situation in which there is a Undistributed Savings, but these savings (Step 11) do not exceed the cost reductions shown in Step 13. In this case, the full value of the cost reductions cannot be paid to the employees and only the value of the Undistributed Savings goes into the bonus pool. Case (c) represents the situation in which the Undistributed Savings exceed the cost reductions. In this case, the organization can justify including all of the cost reductions in the bonus pool. However, because the organization has an agreement with its Headquarters about the reallocation of budget due to cost reductions, then the number in Step 14 will be capped by the amount of Step 13. In the example here, we assume that all of the cost reductions will go into the second pool ($600,000, the same number as in Step 13) because the agreement with headquarters allowed up to $1,000,000 to be reallocable to the Awards Budget.

Step 16: This last step simply combines the two bonus pools (Step 10 and Step 14) into a total pool. All of this money is available for payouts to the employees. In this case, the employees would share (according to the distribution rules in the PGS plan) $800,000.

Productivity Gain Sharing Payouts in an Appropriated Fund Organization (Separate Index Method)

We discussed the advantages of the separate index method under the unit cost organizations (i.e., separate indexes are easier to monitor and control, separate indexes are compatible with current accounting systems). Those advantages also apply for appropriated fund activities. A separate indexing of Key Result Areas in an appropriated fund organization is not fundamentally different from the case of a unit cost organization. Improvements in outputs would be measured in quantitative terms, and then adjusted by increases or decreases in the quality indicators. Precisely how the adjustment would be made is an issue that must be negotiated with the headquarters' command.

Conclusions

The above numbers are simplified for the sake of clarity, but the principles remain the same regardless of the complexity of the figures. In the present adaptation of performance indexing for PGS, the performance index table provides the output (and outcome) measure and the costs provide the input measure. Once you have outputs and inputs for both a baseline period and a current period, you can determine the productivity level for both periods (output divided by input). If productivity has improved during the current period relative to the baseline, then a bonus pool is available and payouts can be made according to the rules established in the PGS plan. The beauty of performance indexing is that productivity improvement is not limited merely to the quantity of goods and services. Quality can be incorporated into the productivity figures, along with any other aspect of performance that the organization chooses to emphasize (e.g., health, safety, EEO goals, employee satisfaction).

Once the basic principles of performance indexing are understood, an organization can make many adjustments and create many variations. For example, the base costs can be adjusted by the Consumer Price Index to convert the costs into today's dollars. As another example, if an organization is made up of several relatively independent departments, each department can create its own performance index table and these different tables can be aggregated ("rolled up") into one larger table for the organization as a whole. As a final example, performance indexing allows an organization to make different adjustments to the inputs so that certain cost categories can be included or excluded. The flexibility and utility of performance indexing makes it an ideal tool for measuring productivity in a white collar environment where performance is hard to measure and improvements are difficult to judge. Performance indexing is especially useful for PGS because it reveals improvement in a way that can be readily translated into dollar savings for a PGS bonus pool. Although there are other measurement methodologies (e.g., Felix & Riggs, 1983; Jones et al., 1990, 1991; Nebeker & Tatum, 1996; Pritchard et al., 1989, Pritchard & Roth, 1991), performance indexing as described here provides an excellent entrée into the confusing and complicated world of performance measurement, and provides a reasonable basis for making PGS payouts.

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